

# **Accu-Step HS Optically Isolated 4 Axis Breakout Board with Home via Index Function**

## **Installation Manual**

Rev 2.1



**CNC Building Blocks**

**Macon, NC 27551**

**252-257-0539**

## **Introduction:**

CNC Building Blocks Accu-Step break out board is designed to allow users to quickly and easily interface Stepper and Servo Drives to software such as Mach2/3 and EMC which uses the PC parallel port to control CNC related equipment.

**It also meets a long needed feature to position the axes of the machine accurately during homing sequences. By using the Home switch in conjunction with the Index pulse from the encoder a very precise trigger position is captured by the card and turns on the Home input to Mach3. As Mach3 backs away from the limit an internal 12 bit counter counts the encoder lines and turns off the home signal to Mach3 at a user programmable count. This insures the home input to Mach always occurs at the same point electronically in reference to the encoder and home switch position.**

## **List of features:**

1. Fully optically isolated parallel port interface using 10 MHz opto-isolators.
2. Separate power and ground for PC and Control Side.
3. Female DB25 connector for easy interface to the PC.
4. Differential or single ended inputs.
5. Differential or single ended outputs which sink or source 20 milliamps.
6. Digital charge pump enable line.
7. Homing logic to home machine to limit and encoder index.
8. Dip switch for each axis to control distance from limit during home sequence.
9. High quality terminal strip for control wiring.
10. Socket mounted IC's that can easily be replaced in the field.
11. LED indicators to allow easy set up.
12. Limit switch and general purpose inputs only require a connection to the control side power supply ground.
13. Inputs and outputs are labeled as to function and not just a number.
14. Encoder signals are driven through the card making wiring much neater and convenient.
15. Includes easy mounting plastic board carrier.

The diagram is a detailed top-down layout of a PC board. It features a central area with four large rectangular components labeled 'AXIS 1', 'AXIS 2', 'AXIS 3', and 'AXIS 4'. To the left of these axes are four vertical columns of components, each labeled 'AXIS 1', 'AXIS 2', 'AXIS 3', and 'AXIS 4' respectively. These columns contain various input and output pins, including 'GP INPUTS', 'ENCODER HOME SW INPUTS', 'ENCODER HOME SW', 'CONTROL POWER', and 'ENCODER OUTPUTS'. To the right of the axes are four vertical columns of components, each labeled 'AXIS 1', 'AXIS 2', 'AXIS 3', and 'AXIS 4' respectively. These columns contain various input and output pins, including 'GP INPUTS', 'ENCODER HOME SW INPUTS', 'ENCODER HOME SW', 'CONTROL POWER', and 'ENCODER OUTPUTS'. At the top of the board is a large rectangular component labeled 'P-PORT'. Below it are two smaller rectangular components labeled 'PC +5V' and 'PC'. At the bottom of the board is a large rectangular component labeled 'P-PORT'. The board is populated with numerous smaller components, including resistors, capacitors, and integrated circuits, each labeled with a part number or value. The layout is organized into a grid-like structure with various functional blocks and connection points.

## **Prerequisites:**

In order to use the homing features of the card it is required that the system has encoders with an index or “Z” channel output.

It is also recommended that the system be equipped with separate home and limit switches for the axes of the machine.

In order to be able to home the four axes independent of one another a separate home input for each axis is required by the software. The board puts out separate signals for each axis. Each home output is hardware mapped to a separate pin on the parallel port interface.

Any of the home outputs can be disabled and mapped to a standard input pin on the parallel port.

## **Specifications and Mounting:**

PC power required is +5 VDC @ 250 milliamps.

Opto Power required is +5 VDC @ 1 amp.

Opto Isolation speed > 5 MHz.

Encoder interface > 5 MHz.

Card size is 11” x 4” x 1” including plastic mounting track.

To mount the board simply remove the tape strips from the back and stick to the control console. Pressure sensitive tape strip will hold the card in place. The installer is allowed to screw the mounting track to the panel if desired.

Use flat head machine screws or rivets to attach the plastic track and provide an insulation barrier between the card and the screw or use plastic fasteners.

There are also mounting holes in the circuit card so it may be mounted on stand offs with screws or plastic clip style, the holes are 0.150”.

## Input and Output Descriptions:

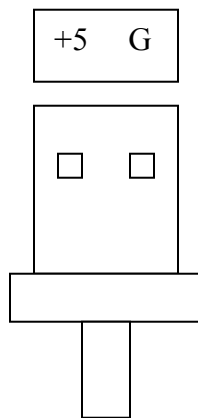
### PC Power Supply:

Terminal strip TS1 is provided for powering the PC side 5 volt supply of the card. There are three terminals, +5, G, and S. The strip is located adjacent to the DB 25 parallel port connector and is clearly labeled “PC +5V”.

Power to this connection can be taken from the USB or floppy drive power connector from the PC. It can also be powered by a separate regulated 5 volt DC supply such as the wall warts sold at Radio Shack, Jameco, and other electronics stores.

Connect the +5 volt wire to the “+5” terminal and the ground or 0 volt wire to the “G” terminal. The “S” terminal is tied to the metal connector shell of the DB 25 connector.

If you plan to use a USB cable to provide power to the card the connector on the PC side of the cable is laid out as follows:



The voltages from the PC are as pictured with the connector positioned as shown and the small open squares (traces visible through the squares) facing toward you. The colors are usually Red for +5 and Black for ground. **You should check your cable first to make sure of polarity before connecting to the card.**

### Opto or Control Power Supply:

Around the perimeter of the circuit card you will find 7 sets of terminals labeled “+V2” and “VG2”. These terminals are for providing the 5 volt DC supply to the card. They also provide an easy connection means to supply +5 and ground reference signals to the interconnected drives such as Gecko, Rutex, ADC, etc.

Power to these terminals is required from a separate source to preserve the isolation between the PC and the controlled devices. Any 5 volt regulated DC supply in the order of 1 amp will suffice. **Do not connect “+V2” or “VG2” to the Terminals “+5” or “G” on the PC Supply terminal TS1.**

You only need to connect + 5VDC to “+V2” and ground to “VG2” at one location as they are paralleled around the board. Jameco sells a nice supply (part# 252726) for around \$12.00 and are well suited to power the card.

## Input Terminals:

**All inputs are inactive (off) when tied to ground.** In other words to activate an input, simply break the connection to ground (VG2) via a switch or opto or any other device. This is done for two reasons, number one is safety, if a cable breaks the input will automatically trigger. The second reason is interface, most devices can sink much more current than they can source. All inputs are pulled high via resistor networks or individual resistors on the card.

Name	P-Port Pin	Function
ESTP	10	Emergency Stop Input.
IN1	11	Input 1. This input is only active if homing is disabled for Axis 1.
IN2	12	Input 2. This input is only active if homing is disabled for Axis 2.
IN3	13	Input 3. This input is only active if homing is disabled for Axis 3.
IN4	15	Input 4. This input is only active if homing is disabled for Axis 4.
H1LS	11	Axis 1 Home Limit Switch. Active only if homing is enabled for Axis 1
H2LS	12	Axis 2 Home Limit Switch. Active only if homing is enabled for Axis 2.
H3LS	13	Axis 3 Home Limit Switch. Active only if homing is enabled for Axis 3.
H4LS	15	Axis 4 Home Limit Switch. Active only if homing is enabled for Axis 4.

## Inputs and Home Switches explained:

As can be seen from the table above inputs IN1 thru IN4 and H1LS thru H4LS use the same pins into the parallel port to send signals to the controller. There are four LED's on the card labeled HMI1, HMI2, HMI3, and HMI4. When homing is enabled the LED's reflect the status of the homing logic, when it is disabled the LED's reflect the status of the input associated with them. It should be obvious from the naming convention that HMI1 is home axis 1 or input 1 depending on the configuration. The same is true for the other inputs or axis home logic, IE: HMI2 is IN2/H2LS, HMI3 is IN3/H3LS and HMI4 is IN4/H4LS.

The home switches are not connected directly to the LED's or the P-Port pins; they are connected through the homing logic on the card to the actual LED or pin and will be explained in the homing section of the manual.

### **Enabling or Disabling Home Logic and Inputs:**

There are four 3 pin jumper headers on the card labeled J5, J6, J7, and J8. Beside the jumpers you will also see a 1, 2, 3 pin identification number. The jumper headers correspond to the axis/inputs as follows:

J5 = Axis 1/IN1

J6 = Axis 2/IN2

J7 = Axis 3/IN3

J8 = Axis 4/IN4

To enable the input (IN1-4), set the appropriate jumper to pin 1 and 2.

To enable homing, set the appropriate jumper to pin 2 and 3

The cards are shipped from the factory with homing enabled on all four axes.

### **Input LED's:**

There are 8 input LED's on the card to facilitate set up and give visual indication of the physical inputs and homing logic state of the card. The following table describes their functions.

Name	Function	Description
HMI1	Home Axis 1 / Input 1	On when Axis 1 home logic is functioning or Input 1 is not grounded. Depends on Enable State
HMI2	Home Axis 2 / Input 2	On when Axis 2 home logic is functioning or Input 2 is not grounded. Depends on Enable State
HMI3	Home Axis 3 / Input 3	On when Axis 3 home logic is functioning or Input 3 is not grounded. Depends on Enable State
HMI4	Home Axis 4 / Input 4	On when Axis 4 home logic is functioning or Input 4 is not grounded. Depends on Enable State
A1INDEX	Axis 1 Index	On when Axis 1 Index pulse is logic high.
A1HMSW	Axis 1 Home Switch	On when Axis 1 Home Switch is not grounded.
A2INDEX	Axis 2 Index	On when Axis 2 Index pulse is logic high.
A2HMSW	Axis 2 Home Switch	On when Axis 2 Home Switch is not grounded.
A3INDEX	Axis 3 Index	On when Axis 3 Index pulse is logic high.
A3HMSW	Axis 3 Home Switch	On when Axis 3 Home Switch is not grounded.

A4INDEX	Axis 1 Index	On when Axis 4 Index pulse is logic high.
A4HMSW	Axis 1 Home Switch	On when Axis 4 Home Switch is not grounded.

### Encoder Inputs:

The card controls 4 axis of motion and allows for 4 encoders to be wired to the card. It is necessary to wire the encoders to the card, as that is what determines the home position after the home switch and index is triggered.

The encoder inputs are differential line receivers and include channel A+, A-, B+, B- and Z+, Z-..

The encoder inputs may be used with differential or single ended encoders such as US Digital and others. Wiring examples will be given later in the manual to show how to hook them up. Essentially if they are differential wire the A+, A-, B+, B- and Z+, Z- directly to the inputs. If they are single ended encoders wire the A+, B+ and Z+ terminals and leave the A-, B-, and Z- terminals disconnected.

Name	Function
A1A+	Axis 1 Channel A+
A1A-	Axis 1 Channel A-
A1B+	Axis 1 Channel B+
A1B-	Axis1 Channel B-
A1Z+	Axis 1 Channel Z+
A1Z-	Axis 1 Channel Z-
A2A+	Axis 2 Channel A+
A2A-	Axis 2 Channel A-
A2B+	Axis 2 Channel B+
A2B-	Axis 2 Channel B-
A2Z+	Axis 2 Channel Z+
A2Z-	Axis 2 Channel Z-
A3A+	Axis 3 Channel A+
A3A-	Axis 3 Channel A-
A3B+	Axis 3 Channel B+
A3B-	Axis 3 Channel B-
A3Z+	Axis 3 Channel Z+
A3Z-	Axis 3 Channel Z-



A1A+	Axis 4 Channel A+
A4A-	Axis 4 Channel A-
A4B+	Axis 4 Channel B+
A4B-	Axis 4 Channel B-
A4Z+	Axis 4 Channel Z+
A4Z-	Axis 4 Channel Z-

Each axis has its own terminal strip with the six encoder inputs as well as the H1LS thru H4LS for that axis. This makes keeping track of each axis wiring very convenient.

There are also 3 sets of +V2 and VG2 spaced between the terminals to facilitate easy power distribution to the encoders.

Each set of axis terminals has a connection called SHLD. This terminal is interconnected to all other SHLD terminals on the card; 8 in all. You can connect one of the terminals to shield ground in the control cabinet and use the rest as a point in the star wiring to keep noise down. It also simplifies wiring of encoder shields.

## Output Terminals:

### Encoder Outputs:

The encoder signals are driven through the board to make wiring easy to accomplish. The encoder outputs are located on the opposite side of the card from the inputs.

The encoder outputs are differential drivers which can source or sink 20 milliamps per channel and are suitable to drive differential, single ended TTL, or opto isolated inputs.

The encoder outputs are labeled exactly the same as the inputs and each strip is set up with 2 axes of encoder channels with +V2, VG2, and SHLD connections located between them.

The index pulses are not brought through as most drives do not require them for operation.

Name	Function
A1A+	Axis 1 Channel A+
A1A-	Axis 1 Channel A-
A1B+	Axis 1 Channel B+
A1B-	Axis1 Channel B-
A2A+	Axis 2 Channel A+
A2A-	Axis 2 Channel A-
A2B+	Axis 2 Channel B+
A2B-	Axis 2 Channel B-

A3A+	Axis 3 Channel A+
A3A-	Axis 3 Channel A-
A3B+	Axis 3 Channel B+
A3B-	Axis 3 Channel B-
A4A+	Axis 4 Channel A+
A4A-	Axis 4 Channel A-
A4B+	Axis 4 Channel B+
A4B-	Axis 4 Channel B-

## Step and Direction Outputs:

The card can control up to 4 servo or stepper drives via step and direction outputs as used by Mach3 and other packages. The step and direction outputs are differential line drivers capable of sourcing or sinking 20 milliamps per pin. This is more than enough current to drive the inputs of any drive made on the market today. The differential pairs are provided for driving units made by ADC, Yaskawa, Etc.

The outputs can also drive single ended drives by just connecting the signal + terminals to the drive and leave the – terminals disconnected.

Differential drives are much less susceptible to noise and are preferred in industrial environments.

The following table lists the Step outputs and their associated P-Port pin numbers for reference. The P-Port pin numbers are silk screened on the card.

Name	P-Port Pin	Function
A1S+	2	Axis 1 Step +
A1S-	Same	Axis 1 Step -
A2S+	3	Axis 2 Step +
A2S-	Same	Axis 2 Step -
A3S+	4	Axis 3 Step +
A3S-	Same	Axis 3 Step -
A4S+	5	Axis 4 Step +
A4S-	Same	Axis 4 Step -

Located between the step terminals and the direction terminals are connections to +V2, VG2, and SHLD

The following table lists the Direction outputs and their associated P-Port pin numbers for reference.

Name	P-Port Pin	Function
A1D+	6	Axis 1 Direction +
A1D-	Same	Axis 1 Direction -
A2D+	7	Axis 2 Direction +
A2D-	Same	Axis 2 Direction -
A3D+	8	Axis 3 Direction +
A3D-	Same	Axis 3 Direction -
A4D+	9	Axis 4 Direction +
A4D-	Same	Axis 4 Direction -

### General Purpose Outputs:

There are three general purpose outputs supported and a forth which can be configured as a general purpose output or the charge pump enable line. This table lists the outputs and their associated P-Port pins.

Name	P-Port Pin	Function
O1	1	General purpose output 1
O2	14	General purpose output 2
O3	16	General purpose output 3
O4EN	17	General purpose output 4 / Charge Pump Enable.

The O4EN signal is a configurable output which can be set as a general purpose output or an active high enable signal. The board logic has a digital charge pump that keeps the output low if the 12 KHz signal is not present from Mach3. The board is shipped with the charge pump enabled as default.

**Caution; the charge pump circuit may trigger the enable line when the computer system is booting up and is only designed to be used as a safety when Mach is operational and in control of the parallel port.**

**Be sure that adequate hard wired protection is designed into the control system to prevent physical harm or mechanical damage.**

There are 2 three pin headers labeled J3 and J4 on the card adjacent to the jumpers for home/input jumpers. The default position for the charge pump enable is both jumpers set on pins 2 and 3. To disable the charge pump and enable output 4 as a general output, remove both jumpers first, and then place them on pins 1 and 2 for each header.

## Output LED's:

The card has LED's associated with each output to aid in setup. Each of the LED's are labeled according to the output they are associated with and are self explanatory.

The LED's are on when the signal from the controller is high or on. If you set your step pulse to active low, then the LED for step will be on except when Mach is producing step pulses. It will never actually go out but dim slightly as the pulse train goes out. The direction LED's will turn on and off as the direction changes.

This feature is invaluable to confirm proper setup. For instance; you set up your ports and pins and you want to make sure they are set correctly, using the configuration menus in Mach you can set the pin from active low to active high and that LED should change state once you press the reset button.

Name	Function
A1S	Axis 1 Step
A2S	Axis 2 Step
A3S	Axis 3 Step
A4S	Axis 4 Step
A1D	Axis 1 Direction
A2D	Axis 2 Direction
A3D	Axis 3 Direction
A4D	Axis 4 Direction
O1	Output 1
O2	Output 2
O3	Output 3
O4CP	Output 4 / Charge Pump

## **Homing:**

The card has logic designed into the 2 CPLD IC's which allows the software to home very accurately. The sequence for homing is as follows:

INITIAL STATE:

System powered up!

Mach 3 is started and the axes are not referenced.

Home switches are in the closed position as indicated by the A1HMSW thru A4HMSW LED's being in the off state.

The HMI1 thru HMI4 LED's are off indicating home outputs are off.

If any of these conditions is not true then the card can be reset by pressing the PB1 button on the card. Make sure the home switches are closed and the limit switch LED's are off first.

The card executes a power up reset sequence, as long as the above conditions are true each of the home outputs will be off.

### **Homing Sequence: (This is relative to Mach2/3 only.)**

Mach is told to Ref the X axis:

1. The axis moves toward the home position.
2. The home switch breaks the circuit to ground and the A1HMSW LED turns on.
3. The home switch open status is latched in the logic.
4. The encoder index pulse occurs and the home output to Mach is turned on, HMI1 LED lights. The index occurred status is latched in the logic.
5. Mach starts to move in the opposite direction. The counters in the homing logic count each encoder **LINE** as it moves off the switch.
6. The home switch closes back to ground and the limit switch input turns off, A1HMSW LED is off. The HMI1 LED is still on and Mach keeps moving the axis away from the switch.
7. Terminal count is reached and the home output to Mach is turned off, HMI1 LED is off.
  - a. Counting is not dependant on direction. This allows the home switch to be placed in any position desired.
8. Mach stops and sets the DRO to match the home position you have set in the configuration for the machine.

This sequence is the same for any axis enabled for homing, substitute the axis number for the 1 in the previous description for each axis. The interface to Mach considers X to be axis 1, Y to be axis 2, Z to be axis 3, and A to be axis 4. The user can obviously change the naming configuration to suit a particular system scheme.

**Setting the distance to move switches:**

Each axis has a dip switch associated with the axis to program the count. The count is loaded into the counter upon the limit opening and can therefore be changed between referencing the axis to update the count distance.

The counts are based on actual line count of the encoder, not the quadrature count, IE; if the system has a 500 line encoder that is 2000 counts as far as Mach is concerned but only 500 counts as far as the card is concerned. This allows the card to be used with very high line count encoders and still get far enough off the switch to allow it to close.

The switches are labeled SW1 thru SW4 for Axis 1 thru Axis 4 respectively.

The dip switches on the card are binary weighted so it is very easy to determine how many counts the system will move off the switch.

There are 8 switches per axis dip switch; each switch is a binary count. If the switch is in the off position its weight is 0. If the switch is on its binary weight is as follows:

Switch Position	Binary Weight or Count
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

The formula for the encoder line count is  $\text{Sum (Switch position 1 thru Switch position 8)} * 16 - 1$ .

With all switches on the total count would be  $128+64+32+16+8+4+2+1 = 255$  counts.

In this case it would be  $(255*16)-1 = 4079$  encoder lines back from the time index is triggered in conjunction with the home switch opening.

If in the previous example all switches were on except SW6 the total count would be  $128+64+0+16+8+4+2+1 = 223$ , so the count would equal  $(223*16)-1 = 3567$  lines.

If only switch 5 is on with all other switches off the formula would be  $(16*16)-1 = 255$  encoder lines.

Note: at least one switch must be on, all switches off is an INVALID state and the home logic will not start.

**It is important to grasp this concept because ideally you only want the system to move back just enough to get the switch to close before the signal is dropped to Mach. The farther the system moves off the switch after it closes just wastes table travel and provides no benefit other than the fact it will always be in the same spot when you home.**

### **Effects of speed versus position count:**

Homing speed will also effect positioning. Let's say for instance you set up the machine to home at 20% of maximum axis velocity. As long as this percentage does not change and tuning is not adjusted (including acceleration, deceleration and axis velocity) the machine will return to the same count from the index pulse as before and the machine relative position will be the same within the machine limits.

But if you change any of the parameters in the above situation the machine will still stop at the exact same count from the index pulse but it will be in a different position.

The reason for this is the time it takes Mach to sample the signals. This would also be true for any digital system as the sampling rate determines trigger frequency. In the case of Mach, or any other controller for that matter, if an axis is moving faster or slower the trigger point is the same (electronically speaking) but the reaction time has been shortened or stretched due to the axis speed change.

This is just a point to keep in mind because you may have set up fixtures and homed to them 100 times and then changed the system and the home position was then affected due to system changes.

**If you change settings, retune drives or any other mechanical changes occur in the operation of the system, reset the fixture or work piece coordinates before continuing.**

### **Other notes on operation:**

These are things that can possibly happen to cause grief.

1. Noisy home switches, if the system has a switch that is noisy or triggers without engaging the trip mechanism the card will not know if the system is trying to home or not. It simply reacts to the changing conditions of signals. So if a switch opens in the middle of travel due to vibration, swarf, or what ever the home output to Mach will be turned on until the terminal count is reached. Mach will not care about this output unless it is in the process of referencing the axis and will continue as normal unless you are trying to use the same switch as a limit which is not recommended.



- a. If you do want to use the home switch as a limit there are a few things to keep in mind.
  - i. When the switch hits the limit the output to Mach will not turn on until the index pulse is triggered.
  - ii. The home output to Mach will remain on until the count you have programmed is reached. This means the limit will be made and the system has to have a way to back the axis up at least the distance programmed.
  - iii. The count does not care what direction the system is traveling so you can use it for + and – limits as long as rule ii is followed.
2. If for some reason the home output is on for an axis when are trying to reference you will get an error from Mach saying the switch is already active and needs to be corrected. Pressing the PB1 reset button should solve this by turning off the output.
3. Backlash, any system capable of homing accurately should have backlash down to a minimum mechanically before trying to maintain an accurate home position. The logic on the card will always synchronize to the encoder but if the drive mechanism is floating around with the motor fixed than nothing can be done to position it properly.

## Setting the Index Location:

It is desirable to have the index occur at equidistant points from the home switch opening position. This is especially true if you plan to use the home switch as a limit also.

To facilitate setting the index position an index LED is provided, the index pulse is very short but can be manually triggered to hold the LED on.

1. To set the index position it is recommended to keep the drives de-energized and isolated for safety reasons. If the system has a timing belt drive remove the belt. If the system is directly coupled remove the coupling device. If the encoders are directly coupled to the lead screw remove the coupling.
2. Next move the axis slowly by hand until the home switch LED lights, stop as soon as it does.
3. If the encoders are directly coupled to the motor, slowly rotate the motor shaft until the index LED for that axis blinks. If the encoders are directly coupled to the screw rotate the encoder manually to achieve the same result.
  - a. Move the encoder or motor shaft very slowly back and forth and you should be able to get the index LED to light or blink between direction changes.
  - b. This location is the 0 degree position of the index pulse.
4. Rotate the motor or encoder shaft 180 degrees in either direction.
5. Mark the shaft position of the motor or encoder and replace the axis drive coupling mechanism.
6. Move the axis away from the switch, by rotating the motor or lead screw, until the home limit switch LED turns off.
7. At this point in time the Home output LED is probably still on. Press PB1 and the home output LED will turn off.
8. Next home the machine manually, by rotating the motor shaft or lead screw toward the switch, and verify the following sequence occurs.
  - a. Home limit switch LED lights.
  - b. Approximately 180 degrees later the Home output LED lights.
9. Rotate the motor or lead screw away from the home switch and verify the following sequence.
  - a. Home limit switch LED turns off and the Home output LED is still lit.
  - b. Continue motion until Home output LED turns off.

This sequence successfully adjusts the switch and gives an indication of the distance away from the switch the home sequence will stop the axis at.

The home switch does not need to stay off through the entire sequence, once the switch triggers the sequence it is not allowed to trigger a second one until the first sequence is complete.

This means that if the home switch turns back off before the index occurs the system does not care and will still trigger the home output on at the next index pulse.

**The home switch must be closed and the home LED off when the system has backed off the switch to home position.**

**CAUTION: IF YOU ARE USING AC OR DC BRUSHLESS DRIVES THAT REQUIRE THE ENCODER FOR COMMUTATION DO NOT MOVE THE ENCODER POSITION ON THE MOTOR OR YOU MAY DISABLE OR DAMAGE THE DRIVE. YOU WILL HAVE TO MODIFY INDEX POSITION BY CHANGING THE POSITION OF THE SCREW IN RELATION TO THE DRIVE.**

Now that we have a reference for the index pulse we can tune the axis to use the least amount of travel to home.

This can be accomplished by using the same procedure outlined above, to get index to occur even closer to the switch opening. Follow the steps above until the switch just opens (home switch LED on) then move the axis screw just a few thousandths further onto the switch.

Next rotate the encoder in the same direction as the screw until the home LED for that axis turns on and lock it down. Once again back the axis up until the home LED and home switch LED is off.

You can fine tune the distances using Mach by setting the jog function to incremental and set the increment to 0.001.

Make sure you are off the home switch and slowly jog one increment at a time until the home switch LED just turns on.

Next continue to jog one increment at a time until the home LED turns on, count the number of key presses this takes and this is the distance from the home switch opening until index occurs. I normally set this value to around 0.010" by adjusting the encoder position.

**Make sure you disable the drive before moving the encoder or the axis motor may take off.**

Jog the axis in the opposite direction one increment at a time until the home switch LED turns off. Continue to jog and count the number of increments until the home LED turns off. This is the distance off the switch to home position. You can now adjust the switches to get a repeatable distance close to the switch.

I normally set most machines for .010" after home switch open till index occurs and .010" from home switch close to home LED off.

Calculation example: 1000 line encoders with 5 TPI screw = .0002 per count or 5 counts per .001". Counts back from home LED on till home switch LED off = .015", Distance off switch desired is .010. Total distance is .025 or 125 counts, closest switch is bit 4 or  $16(8)-1 = 127$  counts.

### Basic XML Settings:

The following table is the basic settings for Mach3 to get started. It contains the pin out for the signal and whether it should be set active high, low or don't care, (DC).

**Make sure you check the enable box for each of the signals as it is not included in the tables.**

### Motor Outputs:

Signal	Step Pin	Dir Pin	Dir Low	Step Low	Step Port	Dir Port
X Axis	2	6	DC	DC	1 or 2	1 or 2
Y Axis	3	7	DC	DC	1 or 2	1 or 2
Z Axis	4	8	DC	DC	1 or 2	1 or 2
A Axis	5	9	DC	DC	1 or 2	1 or 2

### Input Signals:

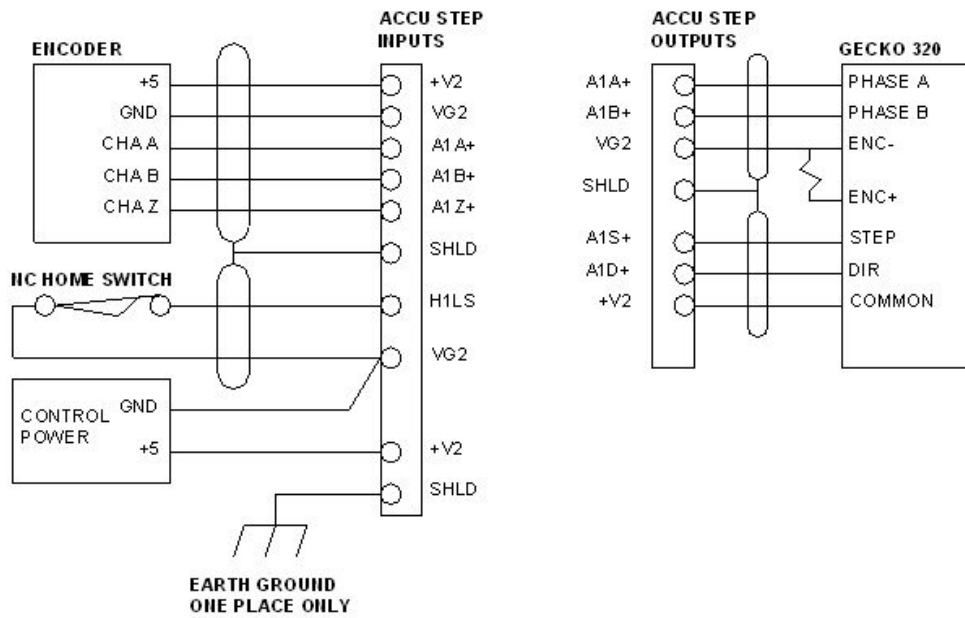
Signal	Port	Pin	Active Low
X Home	1 or 2	11	Not Checked (Must be active High)
Y Home	1 or 2	12	Not Checked (Must be active High)
Z Home	1 or 2	13	Not Checked (Must be active High)
A Home	1 or 2	15	Not Checked (Must be active High)
E Stop	1 or 2	10	Not Checked (Must be active High)

### Output Signals:

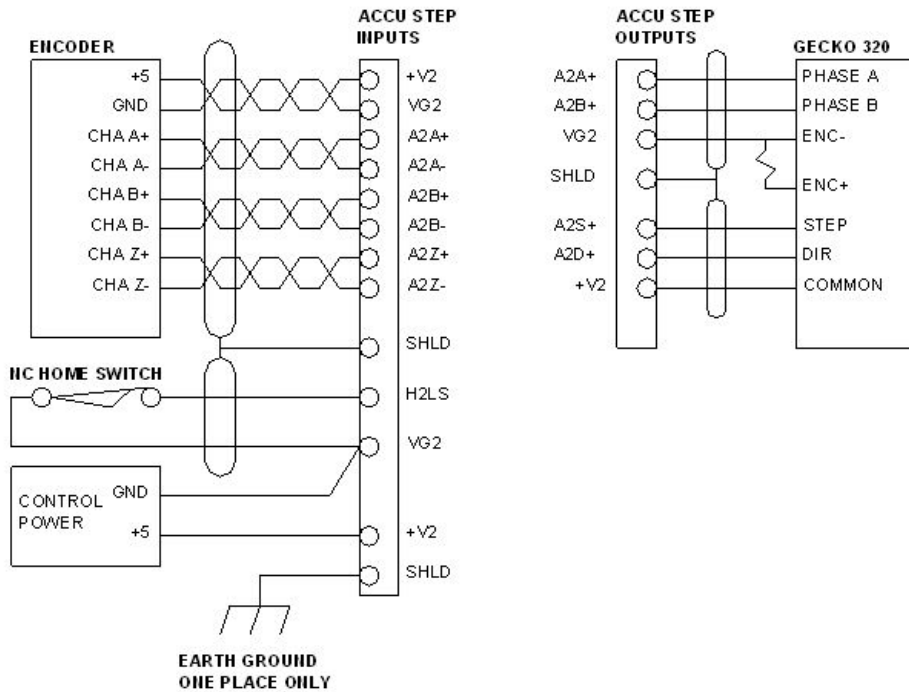
Signal	Port	Pin	Active Low
Out 1	1 or 2	1	DC
Out 2	1 or 2	14	DC
Out 3	1 or 2	16	DC
Charge Pump	1 or 2	17	Not Checked (Must be active High)

## Wiring Examples:

**TYPICAL SINGLE ENDED ENCODER TO SINGLE ENDED DRIVE**



**TYPICAL DIFFERENTIAL ENCODER TO SINGLE ENDED DRIVE**



The diagram illustrates the wiring for the Accu Step motor driver, organized into four main sections:

- ENCODER:** A 5-pin connector with pins labeled +5, GND, CHA A+, CHA A-, CHA B+, CHA B-, CHA Z+, and CHA Z-. It is connected to the corresponding pins on the ACCU STEP INPUTS block.
- ACCU STEP INPUTS:** A central block with pins labeled +V2, VG2, A3A+, A3A-, A3B+, A3B-, A3Z+, A3Z-, SHLD, H3LS, VG2, +V2, and SHLD. It receives signals from the Encoder, Home Switch, and Control Power, and sends signals to the Motor Outputs.
- HOME SWITCH:** A single-pole double-throw switch labeled "H3 HOME SWITCH". One terminal is connected to the H3LS pin on the ACCU STEP INPUTS block, and the other terminal is connected to the VG2 pin on the ACCU STEP INPUTS block.
- CONTROL POWER:** A 2-pin connector with pins labeled GND and +5. The GND pin is connected to the VG2 pin on the ACCU STEP INPUTS block, and the +5 pin is connected to the +V2 pin on the ACCU STEP INPUTS block.
- ACCU STEP OUTPUTS:** A 6-pin connector with pins labeled A3A+, A3A-, A3B+, A3B-, SHLD, A3S+, A3D+, and VG2. It receives signals from the ACCU STEP INPUTS block and sends signals to the RUTEX 2020 motor.
- RUTEX 2020:** A 6-pin connector with pins labeled CH-A+, CH-A-, CH-B+, CH-B-, STEP, DIR, and 0V. It receives signals from the ACCU STEP OUTPUTS block.

**EARTH GROUND ONE PLACE ONLY**

The diagram illustrates the wiring for the Accu Step motor driver. It is divided into four main sections:

- ENCODER OUTPUT FROM DRIVE:** This section shows the connection of the encoder signals. The signals are: CHA A+, CHA A-, CHA B+, CHA B-, CHA Z+, and CHA Z-. These are connected to the corresponding inputs on the driver board.
- IIC HOME SWITCH:** This section shows the connection of the home switch. The switch is connected to the H4LS input on the driver board.
- CONTROL POWER:** This section shows the connection of the control power. The GND is connected to the GND terminal, and the +5V is connected to the +V2 terminal.
- ACCU STEP INPUTS:** This section shows the connection of the step and direction signals. The signals are: +V2, VG2, A4A+, A4A-, A4B+, A4B-, A4Z+, A4Z-, SHLD, H4LS, VG2, +V2, and SHLD. These are connected to the corresponding inputs on the driver board.
- ACCU STEP OUTPUTS:** This section shows the connection of the step and direction signals. The signals are: A4S+, A4S-, A4D+, A4D-, and SHLD. These are connected to the corresponding outputs on the driver board.
- STEP AND DIR INTO DRIVE:** This section shows the connection of the step and direction signals. The signals are: STEP+, STEP-, DIR+, and DIR-. These are connected to the corresponding inputs on the driver board.

**EARTH GROUND ONE PLACE ONLY**

## **Notes on wiring:**

The preceding wiring examples are a reference to help the system designer understand the differences between single ended and differential signals.

The examples show various schemes and also how the card can have mixed mode signals in use. The designer may mix and match several types of interface to the card.

The designer is ultimately responsible for the wiring of the system and should take in all considerations as to shielding and signal pairing.

It is recommended to use shielded cable on all connections even the limit switches.

If you are using differential pairs try to use individually shielded pairs in the interface cables if possible. Run the signals together such as A+ and A-. Do not put A+ and B+ in one pair and the A- and B- in another pair.

If you are connecting to a single ended drive it is recommended to bring the + and – differential signal to the drive even though you are using only one wire at the drive end. This will help with noise immunity in the system.

Try not to run the signal cables close to high voltage power sources or inductive loads.

If you are driving differential signals there is no need to bring a ground reference back for the signals as that is the point of RS422 interfaces. The signal ground may be necessary for other logic though.

If you have questions or problems with the card interface you may call the office between normal business hours Monday thru Friday 9:00 AM till 5:00 PM eastern standard time.

Office number is 252-257-0539.

You may also email us at [co2man@ncol.net](mailto:co2man@ncol.net).

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